SP1

Effect of state characteristics, in particular residual stresses and damage, on the wave propagation

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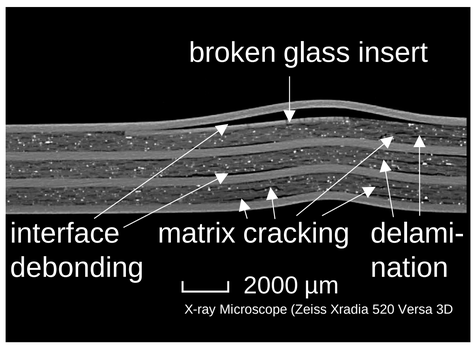
Most Important Preparatory Work

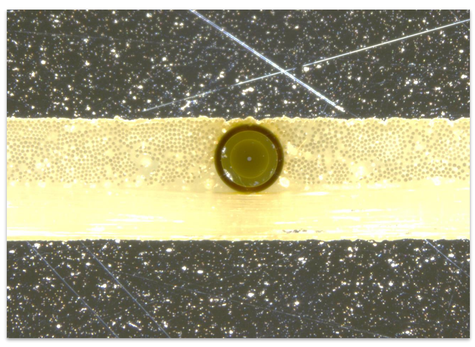
Prof. Dr.-Ing. Christian Hühne
- Application, design, and manufacturing of fibre metal laminates (FML)
- Quantifying residual stresses during FML manufacturing
- Reduction of residual stresses by the use of modified process cycles

Dr.-Ing. Axel von Hehl
- Materialographical characterization of damage patterns in FML
- Observation and assessment of failure behavior of hybrid structures
- Non-destructive characterization of impact damages using X-ray CT

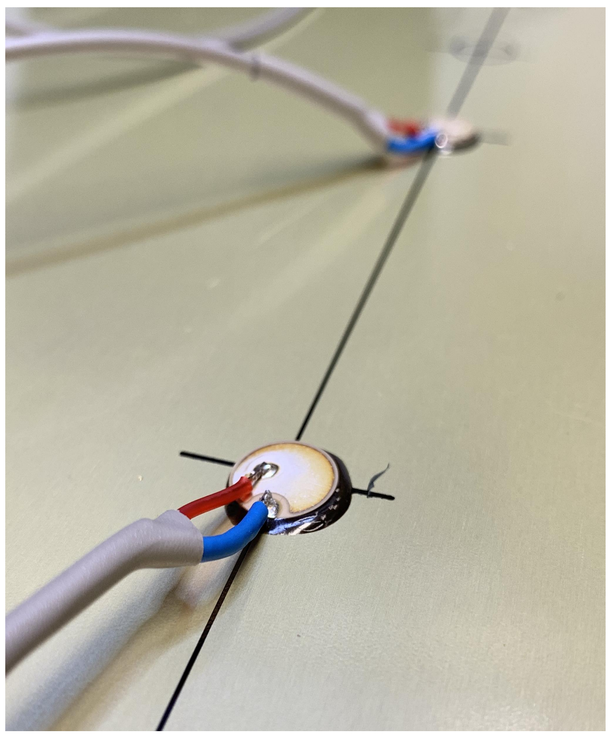
Prof. Dr.-Ing. Axel Herrmann
- Manufacturing of FML and design of hybrid transition structures
- Investigation of guided ultrasonic waves (GUW) under varying loads and environmental conditions
- Development of compensation methods for environmental effects



Impact damage in FML



Embedded FBG-sensor

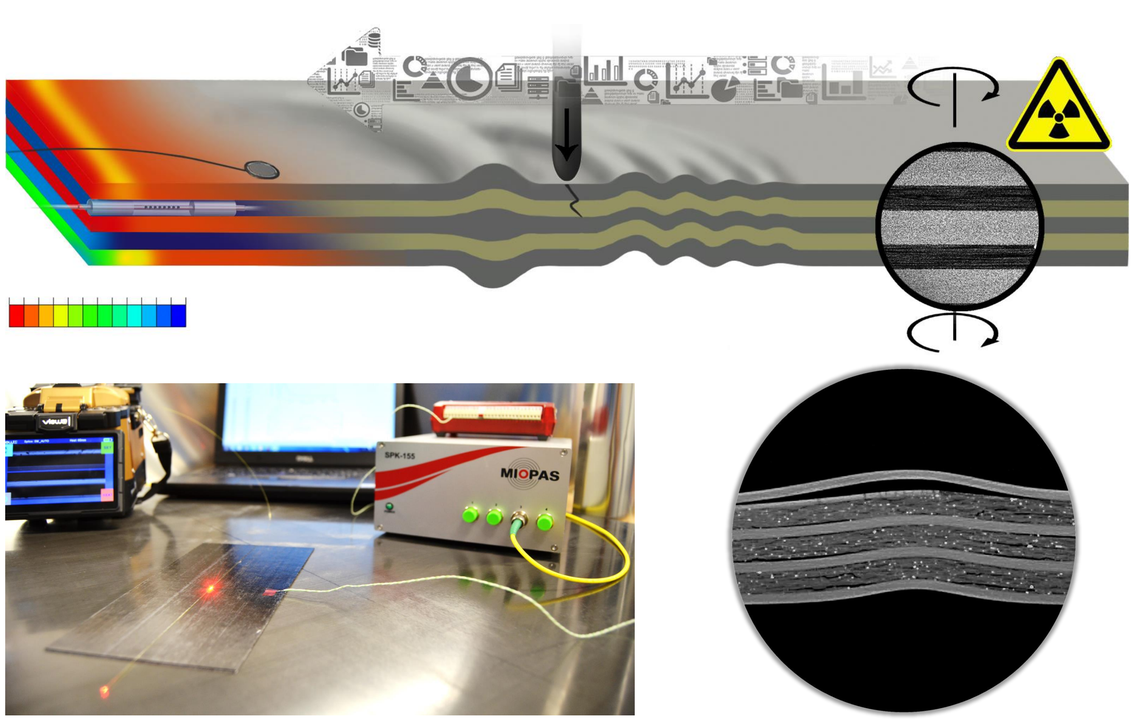


GUW measurement in FML

Objectives of the first funding period

Main Objective:
GUW propagation and damage detectability is determined by residual stress state and damage characteristics

Research Hypotheses:
- GUW propagation depends on ΔT, material components and metal volume fraction (MVF)
- Each state characteristics shows a unique feature in the response of an ultrasonic sensor
- Comprehensive damage classification is possible by detailed analyzation of impact damage characteristics



Residual stress measurement

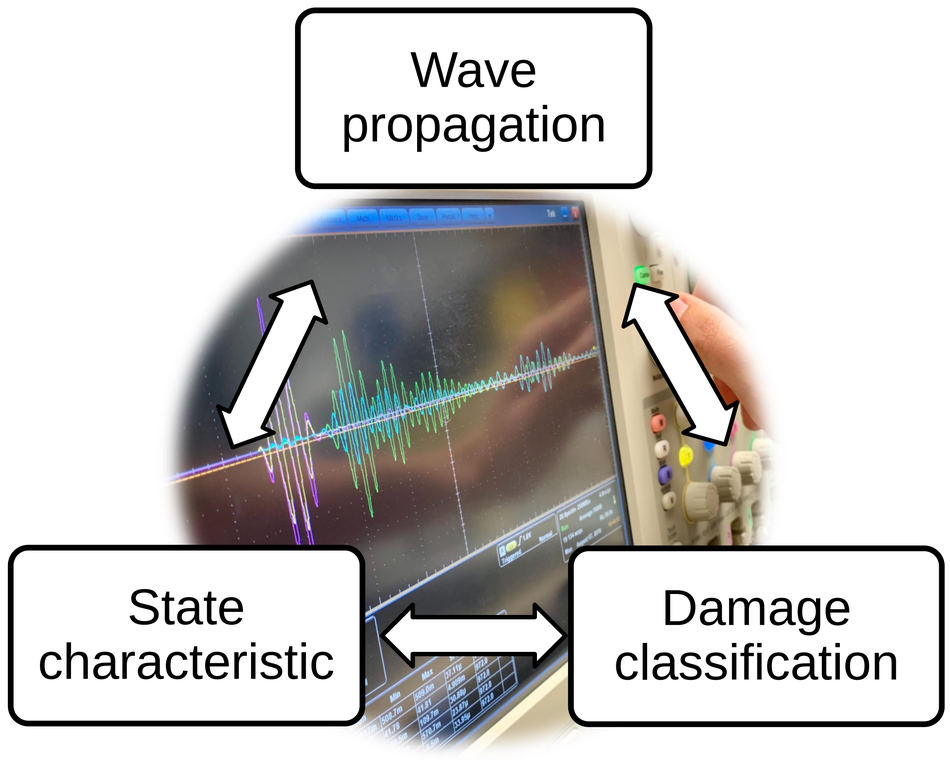
CT–Scan of damaged FML

Methods

Manufacturing process of FML specimens with low and high MVF
- Sensor integration and initial state characteristic
- Artificial defects and impact damage

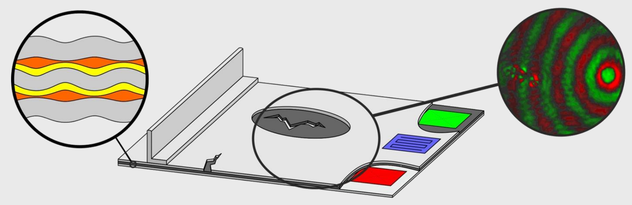
Effects of single state characteristics on GUW
- Intrinsic: specimen type and residual stress
- Extrinsic: environmental condition and defect
- Compensation of non-damage related effects

Characterization and classification of damage in FML
- Determination of the limits of detection and resolution
- Varying of low-velocity impact parameters
- Identification of damage classes from compensated GUW signals



Ultrasonic Monitoring of Fibre Metal Laminates Using Integrated Sensors

Technische Universität Braunschweig | Helmut Schmidt Universität Universität der Bundeswehr Hamburg | Universität Bremen | DLR



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